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EPA Superfund
Record of Decision:

PARA-CHEM SOUTHERN, INC.
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Text:

RECORD OF DECISION

SUMMARY OF REMEDIAL ALTERNATIVE SELECTION

PARA-CHEM SOUTHERN, INC. SUPERFUND SITE

SIMPSONVILLE, GREENVILLE COUNTY
SOUTH CAROLINA

PREPARED BY:

U.S. ENVIRONMENTAL PROTECTION AGENCY
REGION IV
ATLANTA, GEORGIA

DECLARATION FOR THE RECORD OF DECISION

SITE NAME AND LOCATION

Para-Chem Southern, Inc.
Simpsonville, Greenville County, South Carolina

STATEMENT OF BASIS AND PURPOSE

This decision document presents the selected remedial action for the Para-Chem Southern, Inc. Superfund Site (the Site) in Simpsonville, South Carolina, which was chosen in accordance with the Comprehensive Environmental Response, Compensation, and Liability Act of 1980, as amended by the Superfund Amendments and Reauthorization Act of 1986 (SARA), 42 U.S.C. S9601 et seq., and, to the extent practicable, the National Oil and Hazardous Substances Contingency Plan (NCP), 40 C.F.R. Part 300 et seq. This decision is based on the administrative record file for this Site.

The State of South Carolina concurs with the selected remedy.

ASSESSMENT OF THE SITE

Actual or threatened releases of hazardous substances from this Site, if not addressed by implementing the response action selected in this Record of Decision (ROD), may present an imminent and substantial endangerment to public health, welfare, or the environment.

DESCRIPTION OF THE SELECTED REMEDY

This remedial action addresses on-Site and off-Site groundwater contamination, the principal threat at this Site; as well as on-Site sludge contamination.

The major components of the selected remedy include:

- Excavation of contaminated sludge and subsurface soil, with verification sampling;

- Biological treatment of sludge. Treatability studies may be performed if deemed necessary by EPA to evaluate the effectiveness of this process;

- Transportation of the non-biodegradable portions of the sludge and adjacent soils to an approved facility, and treatment of the sludge and soils, if necessary, to comply with land disposal restrictions (LDRs);

- Extraction of contaminated groundwater;

- Treatment of contaminated groundwater using air stripping to remove organic contaminants. Additional pretreatment will beperformed, if necessary, to allow for discharge of the treated groundwater to a local publicly-owned treatment works (POTW);

STATUTORY DETERMINATIONS

The selected remedy is protective of human health and the environment, complies with Federal and State requirements that are legally applicable or relevant and appropriate to the remedial action, and is cost effective. This remedy utilizes permanent solutions and alternative treatment technology to the maximum extent practicable for this Site and satisfies the statutory preference for remedies that employ treatment that reduces toxicity, mobility and/or volume as a principle element. This selected remedy will result in contaminated groundwater remaining on-Site above health-based levels until remedy implementation is complete. Therefore, a five (5) year review will be conducted after initiation of remedial action to insure that the remedy continues to provide adequate protection of human health and the environment.

TABLE OF CONTENTS

LIST OF TABLES

1.0 SITE LOCATION AND DESCRIPTION

The Para-Chem Southern, Inc. site (Site) is located in Greenville County, South Carolina, between Simpsonville and Fountain Inn (Figure 1). The Site is approximately 100 acres of property upon which a manufacturing plant is located. The plant is owned and operated by Para-Chem Southern, Inc. (ParaChem) and is used to produce acrylic polymers, thickeners, latex coatings, and adhesives for a variety of consumer and industrial applications. The plant has been in operation since 1965 and currently employs approximately 150 people.

1.1 Site Description

The Site is located southeast of Simpsonville in Greenville County, South Carolina. The topography at and near the Site consists of gently rolling hills. Land use southwest of the Site is primarily industrial. Elsewhere the land adjacent to the Site is undeveloped. The undeveloped land is generally heavily forested. An elementary and middle school are located approximately one mile east of the Site and a hospital and high school are located approximately one mile west.

Para-Chem acquired the property comprising the Site in four parcels (Plate (1-1). The original parcel was purchased in 1964 and contains the main facility and outbuildings. The second and third parcels were acquired in 1972 and 1973. The fourth parcel was added in 1990 after an exchange of land between Para-Chem and the owner of the adjacent property to the north of the Site. Prior to Para-Chem's purchase of the Site, the property was used for agricultural purposes, primarily cotton and timber farming.

The Greenville City water system serves the majority of area residents. Areas to the north and northeast of Para-Chem which are not serviced by this system obtain water from both private and community wells.

1.2 Site Topography and Drainage

The Site is a grassy field with several paved parking lots and onSite building structures. Surface elevations at the Site decrease toward the northeast, with slopes ranging from 5 to 10 percent. Surface drainage at the Site occurs by overland flow and through several gullies leading northeast towards the unnamed stream. One of the gullies originates north of Lagoon No. 2 and receives a discharge of non-contact cooling water before intersecting the unnamed stream. Two (2) smaller gullies originate south of Lagoon No. 1 and trend to the west toward the stream. These smaller gullies are the source of intermittent streams, with flow limited to the fall and winter seasons. These tributaries discharge into Durbin Creek (see Plate 1-1)

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1.3 Meteorology

The temperature rises to 90 F or above on almost half of the days during the summer months, but usually falls to 70 F or lower during the night. Winters are moderate, with the temperature remaining below freezing throughout the daylight hours only three (3) to four (4) times during a normal year. The mean annual temperature for this area is 60 F. Rainfall is usually abundant and spread fairly evenly throughout the year. The average annual precipitation for this area is 51 inches per year. The prevailing wind directions are generally northeast during the fall and winter, and southwest during the spring and summer months. 2.0 SITE HISTORY AND ENFORCEMENT ACTIVITIES

2.1 Site History

As part of its manufacturing operations, Para-Chem built and used a series of concrete settling basins and two lagoons as part of their past wastewater treatment system (Plate 2-1). Effluent from the lagoons was discharged to a receiving stream, originating on-Site, under National Pollutant Discharge Elimination System (NPDES) Permit SC0001244, issued by the State of South Carolina on November 13, 1984.

The concrete settling tanks were installed in 1965. They consisted of three (3) concrete tanks, rectangular in size, each with a capacity of 1500 gallons. The purpose of the settling tanks was to collect and treat wastewater from the manufacturing plant. Wastewater would flow through a concrete trench to the tanks which were lined up end to end in series. The first tank contained a mixer and alum was added to aid precipitation. The solids settled in the second tank and the liquid overflowed into the third tank for additional settling time. Water from the last tank flowed into Lagoon No. 1.

Sludge from the tanks was occasionally spread in a drying area that formed a shallow pond approximately 50 feet x 50 feet at the rear of Lagoon No. 1. The dried material was eventually spread over the area immediately to the east of the pond.

In 1977, a biological waste treatment plant was built. Agitators were removed from the concrete settling tanks and eventually the tanks were taken out of service. Closure of the tanks consisted of leaving the sludge in place and topping the tanks with soil. A half pipe extension was added to the trench to allow wastes to bypass the settling tanks to the waste treatment plant. This eliminated the use of the settling tanks.

Lagoon #1 was constructed in conjunction with the concrete settling tanks during plant startup in 1965. This lagoon held approximately 1,000,000 gallons of wastewater at any one time. Water levels were maintained by evaporation and seepage to groundwater. As the manufacturing facilities

expanded, more wastewater was produced. This eventually caused Lagoon No. 1 to reach maximum capacity and necessitated the construction of Lagoon No. 2.

Lagoon #1 was cleaned out on two occasions using a drag line and bucket. Material was spread on the ground around the periphery of the lagoon and along the swale west of Lagoon No. 2. Although sludge accumulated at the upper end near the influent pipe, the average sludge depth in the lagoon was three (3) to four (4) feet. Approximately 2000 yards of sludge was removed during each cleaning cycle. The sludge consisted of polymerized latex, clay and calcium carbonate from compounding. The material dried readily and was eventually covered and seeded.

Treated wastewater from Lagoon No. 1 flowed through an underground pipe to Lagoon No. 2. The effluent from Lagoon No. 2 flowed through a catch basin and onto the ground where it eventually reached the stream at the rear of the property. The discharge was controlled by the NPDES Permit. With the construction of the waste treatment plant in 1977, wastewater first went through the waste treatment plant, and then to Lagoon No. 1 prior to discharge. In 1984 Lagoon No. 1 was closed and a pipeline was constructed to direct the effluent to Lagoon #2.

During the closure of Lagoon #1, it was discovered that the sludge was sitting on a clay layer. Both Para-Chem and South Carolina Department of Health and Environmental Control (SCDHEC) decided at that time that it was healty necessary to cover the surface with clay. A gravel and asphalt parking lot was located on top of the closed lagoon. When the plant effluent was tied in toWestern Carolina Regional Sewer Authority in 1987, it was decided to close Lagoon No. 2 as well. Sludge from Lagoon No. 2 was removed and disposed of in a local landfill with SCDHEC approval.

Two (2) spills of ethyl acrylate totaling 3,515 gallons occurred on January 28, 1985, and October 1, 1985, during plant operations at a tank farm west of the plant production area. The spills occurred within an earthen dike containment area. However, a small amount of ethyl acrylate discharged into an adjacent storm drainage ditch. The spills were contained on Para-Chem property. A plant fire on March 16, 1981, resulted in the release of approximately 5,000 gallons of latex material, foam, and water into a drainage channel which leads to a stream which flows to the north across the Site.

A package wastewater treatment system is now in operation at the Site. Treated process wastewater has been discharged to Western Carolina Regional Sewer System (WCRSA) since April 1988. Para-Chem is authorized to discharge non-contact process water under a NPDES Permit at a point source originating on Para-Chem property. The manufacturing portion of the facility operates with an air emissions treatment system approved by SCDHEC.

2.2 Enforcement Activities

On February 27, 1985, Para-Chem notified US EPA and SCDHEC of three areas on the Para-Chem Site where wastes were thought to have been buried between 1975 and 1979. On February 27, 1986, Para-Chem entered into Consent Order 86-17-W, SW with SCDHEC requiring Para-Chem to investigate environmental conditions at the Site. These investigations consisted of geophysical surveys, drilling and well installation, soil and water sampling, and waste removals.

Approximately 3,000 tons of drums, waste materials, soil, and debris were removed from four former disposal areas in 1987. Geophysical surveys were performed to identify the extent of the former disposal areas, andto confirm removal of buried materials.

A groundwater quality assessment program was initiated in 1986 and continued through 1991, including the installation of monitoring wells. Laboratory results of groundwater samples have been submitted quarterly to SCDHEC since March 1989.

Interim remediation of groundwater was initiated with the installation of three recovery wells in 1988. A total of 14 additional recovery wells were added to the system in two subsequent phases. Recovered groundwater is treated at an air stripper prior to discharge to the POTW.

Additional activities included collection of stream surface water, stream sediment, and subsurface sediment samples.

3.0 HIGHLIGHTS OF COMMUNITY PARTICIPATION

Interviews with residents were conducted in January 1992. A Community Relations Plan was developed and an information repository was established at the Fountain Inn Branch of the Greenville County Library in March 1992. A fact sheet announcing the start of the RI/FS was issued in early January 1992. On January 21, 1992, EPA held a public meeting at Bryson Middle School to inform the public of the RI/FS process. The meeting was attended by more than 40 citizens and covered by the local newspaper (Greenville News) and one television station. EPA's presentation to the public included information on how to participate in the investigation and remedy selection process under Superfund. RI field work was initiated in April 1992, and continued throughout the month of May 1992. Additional field work was conducted from July 1992 through December 1992. The final Remedial Investigation/Feasibility Study Report was released to the public and placed in the information repository on June 21, 1993.

Following completion of the RI and the FS, the proposed plan fact sheets were released on June 18, 1993. An advertisement was published in thelocal newspapers on June 19, 1993, informing the public of the proposed plan, public meeting, and the public comment period which extended from June 21, 1993, to July 21, 1993.

The proposed plan public meeting was held on June 29, 1993, to present the Agency's selection of preferred alternatives for addressing soil and groundwater contamination at the Site. Representatives from SCDHEC were present at this public meeting. Public comments and questions are documented in the Responsiveness Summary, Appendix A.

4.0 SCOPE AND ROLE OF THIS ACTION WITHIN SITE STRATEGY

The purpose of the remedial alternative selected in this ROD is to reduce future risks at this Site. The remedial action for contaminated subsurface sludge/soil will remove future health threats by preventing leaching of the contaminants to groundwater. The groundwater remedial action will remove future risks posed by potential usage of contaminated groundwater. Additional activities will include monitoring the threat to surface water in Durbin Creek and the unnamed tributaries in addition to further characterization of the five (5) areas identified during the soil gas survey. This is the only ROD contemplated for this Site.

5.0 SUMMARY OF SITE CHARACTERISTICS

The RI investigated the nature and extent of contamination on and near the Site, and defined the potential risks to human health and the environment based by the Site. A total of thirty nine (39) soil samples, thirty three 33) groundwater samples, six (6) surface water samples, and four (4) sediment samples were collected during the RI. The main portion of the RI (Phase I) was conducted from April 1992 through June 1992, followed by additional bedrock well installation, groundwater sampling and surface water sampling between October and December 1992 (Phase II). On-Site locations of soil borings,soil samples, and monitor wells sampled during Phase I are shown in Plate 5-1. The sampling locations for Phase II are presented in Plate 5-2.

5.1 Geologic and Hydrogeologic Setting

This Site is situated in the Piedmont physiographic province of South Carolina. The Piedmont province is a broad plateau ranging in elevation from 400 to 1200 feet above sea level. The geology of the province consists of highly metamorphosed rocks, primarily gneiss and schists, intruded by igneous rocks. The metamorphic/igneous rocks consist of the following assemblages: granite, biotite schist, granite gneiss, gneiss-schist complex, mica-granite gneiss, and diabase dikes. The bedrock is overlain by a layer of saprolite, slope wash deposits, and alluvial fill material of variable thickness.

The plateau region is dissected by streams which have developed a dendritic drainage pattern. This drainage pattern is characteristic of rock that is resistant to erosion. Stream flow in the province is predominantly to the southeast. Major streams in the province occur in valley bottoms upon a saprolite or slope wash deposit base. Tributaries flow from ridge areas in an irregular pattern to these major streams.

The predominant soils at the Site are classified as Cecil Series and consist of sandy and clayey loams. These are underlain by sands and clays within the saprolite, and a partially weathered rock zone, which is underlain by bedrock.

5.2 Remote Sensing Investigation

The potential for fractured bedrock at the Site was addressed through the use of two (2) remote sensing techniques. Separate subcontractors were retained to perform a Fracture Trace Analysis (FTA) and Very-Low Frequency (VLF) geophysical survey. The results of the study indicate that there are A discernable large scale fracture traces that affect the Site. The only identifiable fracture trace occurs approximately three milessouthwest of the Site. A VLF geophysical survey was conducted at the Site by AGE Co. of Austin, Texas. The survey began on May 4, 1992, but was not completed until May 22 due to bad weather. The VLF geophysical survey was conducted within the areas that contain affected groundwater. The purpose of the survey was to map vertical or steeply-dipping fracture systems, if present, within bedrock. The VLF survey was only partially successful. Several anomalous areas were identified, however, the cause of the anomalies could not be identified with certainty. The results of the VLF survey were taken into consideration, along with other criteria, for selecting the Phase II bedrock drilling locations.

5.1.3 Hydrogeology

The groundwater investigations which were conducted as part of the RI were primarily concerned with groundwater quality. The Phase 1 RI included the collection of groundwater samples from thirteen (13) existing monitoring wells shown in Plate 5-1. Groundwater samples were also collected from the fractured bedrock during packer tests conducted as part of the Phase 2 RI (Plate 5-2). Characteristics of the saprolite, including hydraulic conductivity, groundwater flow rate and direction, and vertical gradients, were addressed during previous investigations. A summary of the these findings is included in Appendix A of the RI.

A direct bedrock investigation was conducted consisting of rock core drilling at eight (8) boring locations and a field check for outcrops of bedrock. The locations of borings B-1 through B-8 are shown on Plate 5-2. Packer testing conducted at borings B-1 through B-8 yielded data which was used to calculate the hydraulic conductivity of the tested interval. Hydraulic conductivity values ranged from 9×10^{-4} cm/sec to 7×10^{-8} cm/sec.

5.2 Nature and Extent of Contamination

Environmental contamination at the Site can be summarized asfollows:

1. Subsurface sludge contains greatly elevated levels of several volatile organic compounds (VOCs) and inorganic contaminants.

2. Groundwater is contaminated with organic contaminants at levels ranging from the detection limit to 110,000 ug/l, and by several inorganic contaminants.

3. Contamination is present in the on-Site tributaries of Big Durbin Creek. Three (3) VOCs, 1,1-Dichloroethene, 1,1,1,-Trichloroethane, and Tetrahydrofuran, are present in the creek at levels of 2.0 ug/l, 2.0 ug/l, and 4.0 ug/l, respectively.

5.2.1 Surface Soil and Subsurface Soils/Sludge

Soil sampling efforts were designed to evaluate the effectiveness of the previous waste removal activities and to investigate other known and suspected disposal areas. A total of thirty nine (39) soil samples were collected during the RI. Based upon historical information that included waste disposal information, surface soil sampling was not evaluated as part of this investigation. Plate 5-3 summarizes the distribution of sludge as it was encountered during the RI.

Former Disposal Areas

Soil Samples were collected from disposal areas No. 1, 2, 3, and 4 (see Plate 5-1). Trace levels of inorganic contaminants (copper, lead, zinc, chromium, and iron) were detected in areas No. 1, 2, and 3, but at levels so low that they do not pose a health risk and will not migrate or leach from the soil into groundwater. One of the samples (HA-13) collected from disposal area No. 4 contained actual wastewater sludge from past plant operations. The organic compounds 1,1,1-trichloroethane, 1,1-dichloroethane, tetrachloroethane, butylbenzylphthalate, and di-n-butylphthalate, were detected at disposal area No. 4. Of particular concern is the 1,1,1-trichloroethane, whichis present at levels requiring sludge remediation.

Former Lagoons

Soil samples were collected from areas surrounding both Lagoon No. 1 and 2. Trace levels of inorganic contaminants were detected, but at levels so low that they do not pose a health risk and will not migrate or leach from the soil into groundwater. Several organic contaminants are also present of which one in particular, 1,1,1-trichloroethane, will require sludge remediation for this area.

Above Ground Tank Area

The levels of the inorganic contaminants aluminum and copper, in addition to the organic contaminant ethyl acrylate, were present, but at levels so low that they do not pose a health risk and will not migrate or leach from the soil into groundwater.

Concrete Settling Basin

The soil samples detected both inorganic and organic contamination in the settling basin. The concentrations of antinomy and 1,1,1trichloroethane will require remediation of sludge from this area.

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Suspected Disposal Areas

Due to the large acreage presented for evaluation and the characteristics of contamination present at this Site, a soil gas screening process was used to investigate suspected disposal areas. Several confirmation samples taken as a check to evaluate the effectiveness of this screening method indicated that, for screening purposes, this particular soil gas technique was acceptable. Based on this screening method, an area associated with H-800 and G-800 (between lagoon No. 2 and disposal area No. 3) will require remediation of sludge and/or soil. The soil gas survey revealed five (5) additional areas that willrequire further characterization. These areas are identified with the following soil gas stations:

- A-900 (east of maintenance shop area),
- D-800 (southwest of disposal area No. 4),
- H-400 (southeast of disposal area No. 2),
- F-300 & F-400 (northeast of production plant)
- D-500, D-643, E-500, E-600 (between production area and lagoon No. 1)

Additional sampling will be necessary during the remedial design to determine whether these areas warrant remediation.

5.2.2 Groundwater

Groundwater Contamination

The groundwater investigation was divided into two (2) phases. Phase I concentrated on the upper portion of the aquifer (saprolite) while Phase II focused on groundwater conditions within the bedrock.

The Phase I sampling results indicated that groundwater within the saprolite is contaminated with both inorganic and organic contaminants. Three (3) of the inorganic and nine (9) of the organic concentrations violated the maximum contaminant levels (MCLs) for those substances.

Phase II results revealed that organic contamination extended into the bedrock at depths down to 100 feet below top of rock. Four (4) of the organic contaminants detected were present in concentrations in excess of the MCL for those substances. In general, concentrations decreased with depth within the bedrock.

Groundwater flow in the Saprolite is toward the northeast. Groundwater contamination extends northeast to the property lines as evidenced by wells MW-22, MW-22A, MW-28, MW-28A, and MW-37 (see Plate 1-1). Contamination was also detected in two (2) off-Site wells (MW-39B and MW-44B), but at levels below the MCLs.

5.2.3 Surface Water and Sediment

Four (4) surface water and sediment samples were initially collected from the tributary at locations along the Site. Both inorganic (aluminum, manganese, iron, and zinc) and organic (1,1-dichloroethene, 1,1,1trichloroethane, and tetrahydrofuran) contaminants were detected in the surface water samples. However, the low concentrations of contaminants in the stream do not warrant remediation at this time. The historical and analytical results suggest that the aquifer is discharging contaminated groundwater into the stream. This stream will be monitored to insure that the contamination does not exceed an acceptable risk level and to verify that the groundwater discharge is acting as the source of contamination for this stream.

Zinc was the only inorganic contaminant present above detection limits for the sediment samples. No organic compounds were detected above the detection limits in either of the sediment samples.

6.0 SUMMARY OF SITE RISKS

Actual or threatened releases of hazardous substances from this Site, if not addressed by implementing the response action selected in this Record of Decision, may present an imminent and substantial endangerment to public welfare or the environment.

A Baseline Risk Assessment was conducted by EPA to evaluate the risks present at the Para-Chem Southern Site to human health and the environment, under present day conditions and under assumed future use conditions. The Baseline Risk Assessment describes the risks to human health and the environment which would result if the contamination present at the Site is not cleaned up. This section of the ROD reports the results of the baseline risk assessment conducted for this Site.

6.1 Human Health Risks

The human health risk assessment evaluated the nature and extent of the threat to public health caused by the release or threatened release of hazardous substances from the Site.

6.1.1 Contaminants of Concern

The contaminated media at the site are groundwater, surface water, sediment and sludge/subsurface soil. Surface soils were not evaluated in the remedial investigation. Historical information indicates that waste was placed in subsurface trenches or burial areas.

The Site land use is currently industrial. Water for drinking at the facility is supplied by the local water company. The Site is expected to remain industrial in the future. Groundwater is currently used as a source for drinking, showering, cooking, dish washing, laundering and gardening for properties surrounding the Site.

Chemicals were included in the discussion of the Site risks if the results of the risk assessment indicated that a contaminant might pose a significant current or future risk or contribute to a cumulative risk which is significant. The criteria for including chemicals in the ROD risk discussion was a carcinogen risk level within or above the acceptable risk range, i.e., 1×10^{-4} to 1×10^{-6}, or a hazard quotient (HQ) greater than 0.1. The groundwater pathway is the only exposure media whose risk levels are at a significant level. For this reason this discussion will focus on the groundwater pathway.

The exposure point concentrations represent the upper 95% confidence limits of the arithmetic means. If the upper 95% confidence limit exceeded the maximum, the maximum concentration was used for the exposure point concentration. The exposure concentration information for the groundwater pathway is presented in Tables 6-1, 6-2, and 6-3.

6.1.2 Exposure Assessment

The potential for current exposure to contaminated media at the Site is highly unlikely. Since water at the Site is supplied by the local water company there is no current exposure to groundwater. In addition, it is highly unlikely that a worker would receive any exposure to subsurface soil, or prolonged exposure to contaminated sediment and surface water. Given the presence of residential areas in the vicinity of the Site and the use of groundwater by some area residents, a future residential scenario was evaluated.

The pathways associated with groundwater at this Site included ingestion of contaminated groundwater, inhalation of volatiles while showering and cooking, dermal (skin) absorption while showering. Other potential exposure pathways evaluated were the incidental ingestion and dermal contact with surface water and sediment. Exposure pathways involving air as a medium were not considered due to the lack of evidence for surficial contamination and extensive grass and vegetative cover at the Site.

Populations that could potentially be exposed to Site contaminants are child and adult residents living on the Site, and children and adults living near the Site who might visit or play on the Site. Based on these potential receptors, seven general future exposure pathways were selected for further numerical risk quantification:

. Ingestion of groundwater

. Inhalation of volatiles while showering and cooking

. Dermal absorption while showering

. Incidental ingestion of surface water[*] <Footnote>* Child (age 7-12 years) resident only</footnote>

. Dermal contact with surface water[*] <Footnote>* Child (age 7-12 years) resident only</footnote>

. Incidental ingestion of sediment[*] <Footnote>* Child (age 7-12 years) resident only</footnote>

. Dermal contact with sediment[*] <Footnote>* Child (age 7-12 years) resident only</footnote>

In order to quantify the exposure associated with each pathway, various standard assumptions were made for key variables in the exposure calculations. These variables include the contaminant level in the medium, usually referred to as the exposure point concentration; and the amount of the contaminant taken into the body, or chronic daily intake, which must be calculated using a number of assumptions. The result of the exposure assessment is a set of tables showing a calculated average daily intake value for each contaminant or compound, as well as a summary value for each exposure pathway.

The exposure assumptions for the groundwater ingestion pathway are contained in Table 6.2. Additionally, for the evaluation of exposure to volatiles from showering, cooking, dish washing and laundering, the assumption was made that this exposure is equivalent to the ingestion rate of two liters/day. The assumptions for the surface water and sediment pathways were for a six (6) year exposure by a twenty seven (27) kg child. The exposure frequency was assumed to be fortyfive (45) days/year and 2.6 hours/day. The water and soil ingestion rates were fifty (50) ml/hour and one hundred (100) mg/day, respectively.

6.1.3 Toxicity Assessment of Contaminants

In this portion of the Baseline Risk Assessment, the toxic effects of contaminants were investigated and evaluated by EPA. The critical variables needed to calculate estimates of risk to human health and the environment were obtained from the EPA toxicological database. Critical toxicity values for the Site contaminants are presented in Tables 6-3 and 6-4.

Slope factors (SFs) have been developed by EPA's Carcinogenic Assessment Group for estimating excess lifetime cancer risks associated with exposure to potentially carcinogenic contaminants of concern. SFs, which are expressed in units of (mg/kg-day)[-1], are multiplied by the estimated intake of a potential carcinogen, in mg/kg-day, to provide the upper bound estimate of the excess lifetime cancer risk associated with exposure at that intake level. The term "upper bound" reflects the conservative estimate of the risks calculated from the SF. Use of this approach makes underestimation of the actual cancer risk highly unlikely. Slope factors are derived from the results of human epidemiological studies or chronic animal bioassays to which animal-to-human extrapolation and uncertainty factors have been applied (e.g., to account for the use of animal data to predict effects on humans).

Reference doses (RfDs) have been developed by EPA for indicating the potential for adverse health effects from exposure to contaminants of concern exhibiting noncarcinogenic effects. RfDs, which are expressed in units of mg/kg-day, are estimates of lifetime daily exposure levels for humans, including sensitive individuals. Estimated intakes of contaminants of concern from environmental media (e.g., the amount of a contaminant of concern ingested from contaminated drinking water) can be compared to the RfD. RfDs are derived from human epidemiological studies or animal studies to which uncertainty factors have been applied (e.g., to account for the use of animal data to predict effects on humans).

Carcinogenic contaminants are classified according to EPA's weightof-evidence system. This classification scheme is summarized below:

Group A: Known human carcinogen.

Group B1: Probable human carcinogen, based on limited human epidemiological evidence.

Group B2: Probable human carcinogen, based on inadequate human epidemiological evidence but sufficient evidence of carcinogenicity in animals.

Group C: Possible human carcinogen, limited evidence of carcinogenicity in animals.

Group D: Not classifiable due to insufficient data.

Group E: Not a human carcinogen, based on adequate animal studies and/or human epidemiological evidence.

6.1.4 Risk Characterization

The final step of the Baseline Risk Assessment, generation of numerical estimates of risk, was accomplished by integrating the exposure and toxicity information. Tables 6-4 and 6-5 present summaries of the total

hazard quotient (non-carcinogenic risk) and total cancer risk associated with the Site. Since the hazard indices associated with the young child are higher than for the older child or adult, only the values for the young child were summarized in this decision document.

For carcinogens, risks are estimated as the incremental probability of an individual developing cancer over a life-time as a result of exposure to the carcinogen. Excess life-time cancer risk is calculated from the following equation:

Risk = CDI x SF

Where:
Risk = a unit less probability (e.g., 2 x 10^{-5}) of an individual developing cancer;

CDI = chronic daily intake averaged over 70 years (mg/kg-day; and

SF = slope-factor, expressed as $(mg/kg\text{-}day)^{-1}$

These risks are probabilities that are generally expressed in scientific notation (e.g., 1 x 10^{-6} or $1E^{-6}$). An excess lifetime cancer risk of 1 x 10^{-6} indicated that, as a reasonable maximum estimate, an individual has a one in 1,000,000 chance of developing cancer as a result of Site related exposure over a 70 year lifetime under the specific exposure conditions at the Site. EPA generally uses the 1E-4 to 1E-6 risk range as an "acceptable risk range" within which the Agency strives to manage risks as part of the Superfund cleanup. Once a decision has been made to take an action, the Agency has expressed a preference for cleanups achieving the more protective end of the range (i.e., 1E-6).

The potential for noncarcinogenic effects is evaluated by comparing an exposure level over a specified time period (e.g., life time) with a reference dose derived for a similar exposure period. The rate of exposure to toxicity is called a hazard quotient (HQ). By adding the HQs for all contaminants of concern that affect the same target organ (e.g., liver) within a medium or across all media to which a given population may reasonably be exposed, the Hazard Index (HI) can be generated. The HQ is calculated as follows:

Non-Cancer HQ = CDI/RfD

Where:

CDI = Chronic Daily Intake

RfD = Reference Dose; and

CDI and Rfd are expressed in the site units and represent the same exposure period (i.e., chronic, subchronic, or short-term). Lifetime carcinogenic risk for a hypothetical future on-Site resident over a thirty (30) year period is estimated to be 6.0 x 10^{-2}. The risk is primarily due to potential ingestion of groundwater and inhalation of VOCs while showering. Risk values of this magnitude exceeded acceptable cleanup goals as described in the National Oil and Hazardous Substances Contingency Plan (NCP), 40 C.F.R. Part 300.430(e)(2). Groundwater ingestion and inhalation of VOCs pathways accounted for the greatest risk associated with this Site. Approximately 99% of the total carcinogenic risk is attributable to exposure to 1,1-Dichloroethene.

Future non-carcinogenic risk is estimated as HI = 310 for future on-Site children and HI = 100 for future on-Site adult residents. In both cases, exposure through ingestion of groundwater and inhalation of VOCs while showering are major contributors to the risk. Exposure to 2-Butanone, 1,1Dichloroethene, 1,1,1-Trichloroethane, and Trichloroethene accounted for the largest percentage of this risk. The risk associated with exposure to surface water and sediment are below the Agency's level of concern.

It should be noted that there is some degree of uncertainty associated with the calculated numerical estimates of human health risks generated in the Baseline Risk Assessment. This is due to the considerable number of assumptions required to provide variables in the equations, and the specific selections of each variable from a range of possibilities.

In the absence of empirical or Site specific data, assumptions are developed based on best estimates of exposure or dose-related relationships. The risk estimates for this Site are based on a number of assumptions that incorporate varying degrees of uncertainty resulting from many sources including:

- Environmental monitoring and data evaluation;

- Assumptions in the selection of exposure pathways and scenarios;

- Choice of models for exposure, and input parameters to these models;

- Choice of models for evaluation of toxicological data in dose-response quantifications, and;

- Assumptions in the expression of noncarcinogenic and carcinogenic risks.

6.2 Environmental Risks

Because land use on the surrounding properties is zoned for both residential and industry usage, the ecological communities surrounding the ParaChem Southern Site have been altered from their natural state. No state or federally designated endangered or threatened species are found at or near the Site. For these reasons, the Baseline Risk Assessment determined that the potential for environmental risks was low.

The following contaminants were selected for evaluation based on their presence in surface water (Inorganics: aluminum, manganese, sodium, zinc; Organics: 1,1-Dichloroethene, 1,1,1-Trichloroethane, Tetrahydrofuran). Only aluminum and zinc were present at concentrations that posed a potential risk to aquatic life. Aluminum levels may pose a risk to aquatic life, however, the onSite levels do not differ from the background levels. This would indicate that the aluminum concentrations can not be attributed to sources originating at the Site and are reflective of background concentrations present in the surface water.

Contaminants present in the sediments that were selected for evaluation consisted of inorganics only (aluminum, manganese, zinc). For these contaminants, only zinc could be evaluated based on available criteria. Zinc levels were below the biological effect levels established by the National Oceanic and Atmospheric Administration, therefore no risk to benthic life is expected on this basis.

Two (2) macroinvertebrate evaluations were performed on this unnamed tributary in June 1985 (Aquatic Analysts) and May 1991 (Shealy ESI). The 1985 report concluded that the Site had impacted the microinvertebrate community within the unnamed tributary. The 1991 report indicated that conditions had improved and the unnamed tributary exhibited good water quality.

The RI Sampling results indicate that groundwater is discharging from the aquifer into the on-Site unnamed tributary at low levels. These levels are not considered ecologically significant at this time. Should these levels increase, which could occur by way of continued movement of the groundwater contaminant plume, contamination could pose an ecological threat to the unnamed tributary.

7.0 REMEDIAL ALTERNATIVES

The Feasibility Study (FS) considered a wide variety of general response actions and technologies for remediating soil and groundwater at the Site. Table 7-1 summarizes these response actions and technologies, and provides the rationale for why each was retained or rejected for further consideration in the development of remedial alternatives.

Based on the FS, Baseline Risk Assessment, and Applicable or Relevant and Appropriate Requirements (ARARs), the remedial action objectives (RAOs) listed below were established for the Site. Alternatives were developed with the goal of attaining these Remedial Action Objectives:

- Prevent ingestion of groundwater containing any carcinogen concentrations above Federal or State limits, or if there is no established limit, above levels which would allow a remaining excess cancer risk of greater than 10[-6] to 10[-4].

- Prevent ingestion of groundwater containing any noncarcinogen concentrations above Federal or State limits, or if there is no established limit, above levels which would allow anunacceptable remaining non-carcinogenic threat (HI greater than 1.0).

- Restore the groundwater system to potential productive use, by cleanup to the standards described above, and by preventing the migration of the pollutants beyond the existing limits of the contaminant plume.

- Prevent ingestion or direct contact with contaminated sludge having greater than a 10[-6] to 10[-4] excess cancer risk, or exceeding the allowable health threat (HI greater than 1.0) for noncarcinogens.

- Prevent migration of contaminants from the sludge to groundwater, which would result in groundwater contamination in excess of Federal/State limits or health-based maximum levels.

- Monitor contaminant concentrations in the unnamed tributary, and maintain water quality in accordance with Federal and South Carolina Ambient Water Quality Criteria for surface waters.

- Characterization of the five anomalies discovered during the soil gas survey through additional sampling.

7.1 Description of Remedial Alternatives

The technologies identified in Table 7-1 considered potentially applicable for remediating the Site were further evaluated on the effectiveness and implementability criteria. Table 7-2 lists those which passed this final screening, and outlines the technology components of each of the five (5) remedial alternatives proposed for remediation.

All alternatives except 1 (No Action) and 2 (Institutional Controls) include sampling to insure that all contaminated groundwater at concentrations that exceeded the remediation goals will not migrate beyond Site boundaries. Additionally, all of the alternatives include six (6) Five (5) Year Reviews to be conducted during the assumed thirty (30) year Operations & Maintenance period. The cost of these reviews, $41,700, is included with the capital costs but was calculated using the same five percent discount factor as O&M costs.

Certain ARARs are applicable to each alternative. Alternatives 2 (Institutional Controls), 3 (Groundwater Treatment) and 4 (Capping of Sludge and Groundwater Treatment) would not satisfy the requirements of the South Carolina Hazardous Waste Management Regulations (SCHWMR), Reg. 61-79.264, which require removal of contamination "to the maximum extent possible." Alternative 5 (Treatment of Sludge with Groundwater Treatment would, assuming successful implementation, comply with this ARAR. Alternatives 3 (Groundwater Treatment), 4 (Capping of Sludge and Groundwater Treatment) and 5 (Sludge Treatment and Groundwater Treatment) involve materials handling and potential generation of particulates, and/or VOC emissions from treatment, and thus, must comply with the South Carolina Ambient Air Quality Standards (AAQS) which implement the South Carolina Pollution Control Act, and the National Emission Standards for Hazardous Air Pollutants (NESHAP) under the Clean Air Act. Alternative 5b (Sludge Treatment through Landfilling) includes landfill disposal of a potential hazardous waste and, therefore, could be required to comply with RCRA land disposalrestrictions (LDRs), (40 C.F.R. Part 268, SCHWMR 61-79.268) if the sludge and/or soils are shown to be hazardous wastes subject to land disposal requirements (40 C.F.R. Part 261, SCHWMR 61-79.261). Finally, U.S. Department of Transportation (DOT), EPA (40 C.F.R. Part 262), and SCDHEC (SCHWMR 61-79.262) regulations governing the transportation of hazardous materials would also apply to Alternative 5 if the sludge and/or soils prove to be hazardous waste.

The treatment system related to Alternative 5a (Thermal Destruction of Sludge) and 5c (Biological Treatment of Sludge) may produce a residual sludge that may be subject to the identification (40 C.F.R. Part 261, SCHWMR 6179.261), transportation (40 C.F.R. Part 262, SCHWMR 61-79.262), manifestation (40 C.F.R. Part 263, SCHWMR 61-79.263), and land disposal restriction (40 C.F.R. Part 268, SCHWMR 61-79.268) requirements of RCRA, if the resulting residual sludge is determined to be a RCRA hazardous waste.

Additionally there are ARARs which are applicable, or relevant and appropriate, to each of the alternatives addressing groundwater. Site groundwater is classified by South Carolina as Class GB (SC Water Classifications and Standards, Regulation 61-68), and by EPA as Class IIB (Guidelines for Ground Water Use and Classification, EPA Ground Water Protection Strategy, US EPA 1986). Alternative 2 (Institutional Controls) would not meet the relevant and appropriate ARARs concerning groundwater as a potable water source, the National Primary and Secondary Drinking Water Standards, promulgated in 40 C.F.R. Parts 141-143, and the State of South Carolina Primary Drinking Water Regulations, SC Reg. 61-58, because Site groundwater violates numerous MCLs specified in these regulations. Also, ?? CERCLA preference for treatment to reduce toxicity, mobility, or volume ?? contaminants wherever possible would not be satisfied by this alternative. The remaining alternatives 3 (Groundwater Treatment), 4 (Capping of Sludge with Groundwater Treatment) and 5 (Disposal ofSludge with Groundwater Treatment) would achieve these standards. Alternatives 3 (Groundwater Treatment), 4 (Capping of Sludge and Groundwater Treatment) and 5 (Disposal of Sludge and Groundwater Treatment) would be subject to the following major applicable ARARs: South Carolina Ambient Air Quality Standards (SC Regulation 62.5), National Emissions Standards for Hazardous Air Pollutants (NESHAPs, 40 C.F.R. Part 61), Clean Water Act Discharge Limitations (40 C.F.R. 403.5), and the Clean Water Act Pretreatment Standards (40 C.F.R. Parts 122, 125, 129, 133, and 136).

The "O&M cost" included for each alternative refers to the costs of operating and maintaining the treatment described in the alternative, for an assumed period of thirty 30 years. All of the Alternatives except Alternative 1 (No Action) have anticipated O&M costs. Such costs would include, primarily, periodic inspections of the Site. The O&M costs were calculated using a five percent discount rate per year.

7.2.1 Alternative 1: No Action

The No Action alternative is retained as the baseline case for comparison with other alternatives. No remedial actions would be performed on the media of concern at the Site. For the purpose of evaluating the "No Action" alternative, it will be assumed that the existing groundwater extraction and treatment system is not operating. The entire Site, as defined during the RI, would remain in its present condition. The only active component of this alternative is long-term groundwater monitoring. This program would be implemented to assess the effect of waste contaminants on the Site over a thirty (30) year design life. Groundwater at the Site would be sampled and analyzed semiannually for Site-specific contaminants of concern. The monitoring program would be reevaluated every five (5) years to assess the appropriateness of the sampling program. Twenty-five (25) of the existing wells at the Site wouldbe used to monitor groundwater quality. Because hazardous contaminants would remain on-Site, a five year review would be required under Section 121(c) of CERCLA, 42 U.S.C. 9621(c).

Capital Costs:	$ 130,000.00
Annual O&M Costs:	$ 129,000.00
Total Present Worth Costs:	$ 2,108,000.00

7.2.2 Alternative 2: Institutional Controls

The Institutional Controls alternative includes physical and legal components that block exposure pathways to waste contaminants in sludge and groundwater. For the purpose of evaluating the "Institutional Controls" Alternative, it will be assumed that the operating groundwater extraction and treatment system is not operating. These institutional measures include the following:

- long term monitoring as presented in Alternative 1;
- fencing of the concrete settling basin; and
- deed restrictions to control future land and groundwater use at the Site.

Institutional controls for the affected sludge at the Site would be implemented by restricting access to affected Site areas with security fencing and deed restrictions at the Site. Security fencing installed as part of this alternative would consist of a six (6) foot high chain-link fence with at least one strand of barbed wire extending along the top. The fenced area would be posted and gates kept locked. In addition to fencing, legal actions would be taken to attach deed restrictions that would control future access and land use in the event the Site property is transferred to another owner.

Institutional controls for affected groundwater beneath and downgradient of the Site would consist of periodic groundwater monitoring as described in Alternative 1 and measures that would limit exposure to groundwater from the Site. Access to Site groundwater would be restricted by deedrestrictions that would preclude future residential use of the groundwater by the current or subsequent land owners. Long-term monitoring at the Site would be conducted as described in Alternative 1 (No Action).

Capital Costs:	$ 152,000.00
Annual O&M Costs:	$ 129,000.00
Total Present Worth Costs:	$ 2,130,000.00

7.2.3 Alternative 3: Groundwater Extraction & Treatment

This alternative combines the options described in Alternative 2 (Institutional Controls, with operation of the existing (or modified) groundwater extraction and treatment program. This alternative includes the following components:

- long term monitoring as presented in Alternative 1;
- institutional controls as presented in Alternative 2 for the known contaminated portions of the aquifer;
- groundwater flow containment and extraction;
- groundwater treatment; and
- discharge effluent to POTW.

Groundwater flow containment would initially be accomplished by using the currently operating fourteen (14) recovery wells (RW-4 through RW17) that are currently operating at the Site. The system will operate for approximately thirty (30) years. The wells extend in an arc from south to north approximately parallel to the eastern property line. During the Remedial Design/Remedial Action phases of the project, the need for upgrades to the existing system, including the addition of bedrock extraction wells will be evaluated. In the interim, recovery wells RW-2 and RW-3 will be upgraded and added to the existing jet pump extraction system. The existing well locations are shown in Plate 1-1. Currently, the wells (RW-4 through RW -17) extract approximately 30 gallons per minute (gpm).

The volatile organic contaminants of concern at the Site have been shown to be effectively removed from groundwater by air stripping. Those inorganic has not addressed by the on-Site treatment system will receive treatment at the POTW. Para-Chem has an operating permit (Permit No. IO-1182) for discharge of treated water to the Western Carolina Regional Sewer Authority (WCRSA). WCRSA requires monthly monitoring of discharge to evaluate treatment system performance. Monthly sampling is expected to continue under this treatment alternative in accordance with WCRSA pretreatment requirements. Treatment of groundwater by air stripping is currently meeting WCRSA permit requirements.

After treatment, groundwater extracted from beneath the Site is piped to the Western Carolina Regional Sewer Authority (WCRSA) Durbin Creek plant. The WCRSA currently requires that Para-Chem effluent be monitored on a monthly basis for volatile organic compounds and zinc. The treatment program proposed under this alternative would continue those analyses, as prescribed by WCRSA.

In addition to groundwater extraction and treatment from the saprolite, a minimum of two recovery wells will be installed within the shallow bedrock zone adjacent to bedrock borings B-1 and B-8. EPA may require the conversion of several of the bedrock borings to monitoring points. Each interval containing detectable concentrations of VOCs will be monitored. The rationale for the dual (2) groundwater program of monitoring and extraction is based on two considerations: remediating the zones with the highest concentrations of contaminants; and, controlling the hydraulic effects of drawdown. The need for additional wells will be determined based on evaluation of the system's effectiveness and monitoring results.

Capital Costs:	$ 630,000.00
Annual O&M Costs:	$ 281,000.00
Total Present Worth Costs:	$ 4,944,000.00

7.2.4 Alternative 4: Capping of Sludge with Groundwater Treatment

This alternative combines Alternative 2 (Institutional Controls) and the groundwater treatment program of Alternative 3 with installation of an impermeable cap over the concrete settling basin. Sludge disposal areas will be investigated during the Remedial Design. Sludge identified during the investigation will be consolidated in the area of the concrete settling basin prior to capping. The purpose of capping is to reduce contact by receptor populations and the environment with waste contaminants found at the Site. This reduction would be accomplished by minimizing vertical migration of waste contaminants, preventing erosion of affected Site materials, and providing a barrier to direct contact. The cap would cover the sludge containing organic and inorganic compounds at concentrations that exceed the sludge remedial action targets. The concrete settling basin has a surface area of approximately 250 square feet. Figure 6-4 shows the plan view of a conceptual layout for this alternative.

An impermeable cap would minimize contact between percolating water and waste contaminants, thereby reducing the potential for migration of waste contaminants to the groundwater. In addition, a cap installed over the affected materials would prevent erosion of waste contaminants by wind or surface water runoff. Adjacent surface areas would be graded, as necessary, to divert surface drainage around and away from the contained solids. A containment cover of this type would require periodic maintenance and inspection.

Capital Costs:	$ 716,000.00
Annual O&M Costs:	$ 302,000.00
Total Present Worth Costs:	$ 5,358,000.00

7.2.5 Alternative 5: Excavation of Sludge with Groundwater Treatment

Alternative 5 consists of the groundwater treatment program presented in alternative 3 with removal of sludge with concentrations of contamination exceeding remediation goals. The known areas include the concretesettling basin and locations near CS-06, HA-13, and HA-16. This alternative includes two options for sludge removal: a) excavation; and, b) pumping. This alternative also includes three options for sludge treatment/disposal: a) offSite treatment by thermal destruction; b) off-Site disposal of the sludge in a secure landfill; and c) on-Site biological treatment of the sludge in the existing waste treatment unit. Treatment by thermal destruction using a rotary kiln was selected on the basis of commercial availability and a history of prior application to similar wastes. Biological treatment in the on-Site activated sludge unit was selected on the basis of availability, ease of implementation, and a history of prior application to similar wastes.

For sludge that may be affecting groundwater quality, the first step in this alternative would include removal from the concrete settling basin and from areas near HA-13, HA-16, and other areas that may be identified during future investigations. Following sludge removal the in-ground concrete tank will be removed and sampled to evaluate proper disposal options. Confirmatory testing will be conducted at the limits of the excavation. If adjacent soils exceed remediation target concentrations for protection of groundwater, these soil will be removed. Alternative 5a of this alternative, affected soils, if present, would be excavated and treated by thermal destruction. The solid wastes requiring treatment are estimated to consist of approximately 200 in-place cubic yards of affected sludge. The recent of subsurface excavation would be determined by collection and analysis of confirmation samples from underlying soil after the removal of the sludge and visibly-affected soil.

Sludge may require dewatering prior to implementation of thermal destruction or land disposal. However, even if the moisture content is high, the relatively small volume of material might eliminate the need for special handling prior to treatment or disposal. High moisture content will be required for implementation of Alternative 5c (biological treatment) alternative. Each treatment facility evaluated during remedial design will be fully operational and in compliance with the applicable regulations. Disposal of treatment residuals would be in accordance with facility permit requirements.

Each of the treatment process options could require preprocessing of the solids to remove debris and to reduce the particle size of the waste matrix. At other Sites where larger volumes of heterogenous wastes are excavated for treatment, a one-percent rejection rate is often used to obtain more accurate cost estimates. However, since the quantity of material in and adjacent to the concrete settling basin is comparatively small, the cost and economic analysis of this alternative assumes that the entire mass of sludge will be treated.

Clean backfill would be placed in the excavated concrete settling basin. The graded cover would be sown with shallow-rooted grasses to reduce erosion. The restored area would receive periodic maintenance and inspection.

The selected waste transporter required for Alternatives 5a and 5b must be in compliance with applicable federal and state environmental and public health statutes applicable to the waste contaminants identified at the Site. If necessary, RCRA manifests, as required under 40 C.F.R. Parts 262 and 263, would be completed for all wastes shipped off-Site. Vehicles transporting from the Site would be licensed by the Department of Transportation (DOT) and would display the proper DOT placard.

Option 5a: Incineration

Capital Costs:	$ 1,792,000.00
Annual O&M Costs:	$ 281,000.00
Total Present Worth Costs:	$ 6,106,000.00

Option 5b: Off-Site Land Disposal

Capital Costs:	$ 1,271,000.00
Annual O&M Costs:	$ 281,000.00
Total Present Worth Costs:	$ 5,585,000.00

Option 5c: On-Site Biological Treatment

Capital Costs:	$ 1,184,000.00
Annual O&M Costs:	$ 281,000.00
Total Present Worth Costs:	$ 5,498,000.00

8.0 SUMMARY OF COMPARATIVE ANALYSIS OF ALTERNATIVES

The five (5) alternatives were evaluated based upon the nine (9) criteria set forth in 40 C.F.R. 300.430(e)(9) of the NCP. In this section, brief summaries of how the alternatives were judged against these nine criteria are presented. Also included is a description of the criteria. For ease of reference, the five (5) alternatives considered are listed in Table 8-1.

8.1 Threshold Criteria

Two (2) threshold criteria must be achieved by a remedial alternative before it can be selected.

1. Overall protection of human health and the environment addresses whether the alternative will adequately protect human health and the environment from the risks posed by the Site. Included in judgement by this criterion is an assessment of how and whether the risks will be properly eliminated, reduced, or controlled through treatment, engineering controls, and/or institutional controls.

Alternative 1 (No Action) would not achieve protection of human health and the environment. Risks identified in the Baseline Risk Assessment would continue to exist. Alternative 2 (Institutional Controls) would produce limited protection by preventing human contact with contaminated groundwater and sludge/soil by restricting aquifer and property usage; however, the potential threat to the on-Site stream from contaminated groundwater discharge would remain. Alternative 3 (Groundwater Treatment) would achieve a moderate degree of protection. Further migration of the groundwater contaminants would be prevented, and groundwater extracted at the leading plume edge would be treated prior to discharge to WCRSA.

Alternative 4 (Capping of Sludge with Groundwater Treatment) would provide additional protection by reducing rainfall infiltration through the contaminated sludge and/or soil, thereby reducing the amount of contamination leaching to groundwater. Alternative 5 (Excavation of Sludge and Groundwater Treatment) would achieve the highest degree of protection through the removal of sludge and soil which would eliminate the source of contamination to groundwater.

2. Compliance with applicable or relevant and appropriate requirements (ARARs) addresses whether an alternative will meet all of the requirements of Federal and State environmental laws and regulations, as well as other laws, and/or justifies a waiver from an ARAR. The specific ARARs which will govern the selected remedy are listed and described in Section 9.0, Selected Remedy.

In evaluating compliance with ARARs, contaminated sludge and soil will be analyzed to determine if they will be categorized as a hazardous waste as defined under RCRA and the South Carolina Hazardous Waste Management Regulations (SCHWMR). Should the contaminated sludge and soils fail Toxicity Characteristic Leachate Procedure (TCLP), then 40 C.F.R. Parts 261, 262, 263, and the corresponding parts under the SCHWMR, will apply. Also, if the contaminated sludge and soils fail TCLP, the land disposal restrictions in 40 C.F.R. Part 268 and SCHWMR 61-79.268 will apply. However, if Extraction Procedure (EP) toxicity tests are performed and the contaminated sludge and soils do not exceed EP toxicity limits, then the land disposal restrictions cited above will not apply, even though the contaminated soils fail TCLP.

The evaluation of the ability of the proposed alternatives to comply with ARARs included a discussion of chemical-specific and action-specific ARARs presented in Section 7.1. There are no known location-specific ARARs for the Site. All the alternatives, with the exception of Alternatives 1 (No Action) and 2 (Institutional Controls), will meet their respective ARARs at the completion of the remedial activities. Each of these alternatives involves a more aggressive extraction scheme which would recover and treat groundwater.

8.2 Primary Balancing Criteria

Five (5) criteria were used to weigh the strengths and weaknesses among alternatives, and to develop the decision to select one of the alternatives once the threshold criteria was met.

1. Long term effectiveness and permanence refers to the ability of the alternative to maintain reliable protection of human health and the environment over time, once the remediation goals have been met.

Alternatives 1 (No Action) and 2 (Institutional Controls) would not meet this criterion. Alternatives 3 (Groundwater Treatment), 4 (Capping of Sludge and Groundwater Treatment) and 5 (Excavation of Sludge and Groundwater Treatment) would achieve and maintain a high degree of effectiveness and permanence. If implemented successfully, Alternative 5 (excavation of Sludge and Groundwater Treatment) would achieve the highest degree of effectiveness and permanence through removal of sludge and soil which acts as a source of contamination to groundwater.

2. Reduction of toxicity, mobility, or volume addresses the anticipated performance of the treatment technologies that an alternative may employ.

The 1986 amendment to CERCLA, the Superfund Amendments and Reauthorization Act (SARA), directs that, when possible, EPA should choose a treatment process that permanently reduces the level of toxicity of Site contaminants, eliminates or reduces their migration away from the Site, and/or reduces their volume on a Site.

Alternatives 1 (No Action) and 2 (Institutional Controls) would not meet this criterion since no treatment would occur. Alternatives 3 (Groundwater Treatment) and 4 (Capping of Sludge and Groundwater Treatment) would achieve varying degrees of mobility, toxicity and volume reduction. Alternative 5 (Excavation of Sludge and Groundwater Treatment) would achieve the greatest degree of reduction of toxicity, mobility, and volume through excavation and treatment of sludge and soil which is acting as a continuing source of contamination to groundwater.

3. Short-term effectiveness refers to the length of time needed to achieve protection, and the potential for adverse effects to human health or the environment posed by implementation of the remedy, until the remediation goals are achieved.

Of all the alternatives that achieve ARARs, Alternative 3 (Groundwater Treatment) affords the greatest level of short-term protection because it presents the least disturbance to the Site. The remaining alternatives could release amounts of volatile emissions during implementation but should be manageable through standard construction practices.

4. Implementability considers the technical and administrative feasibility of an alternative, including the availability of materials and services necessary for implementation.

Implementation is not a concern for Alternative 1 (No Action), since no actions would be implemented. Alternative 2 (Institutional Controls) would require the least effort to implement as it only requires institutional controls. The remaining alternatives, Alternatives 3 (Groundwater Treatment), 4 (Capping of Sludge and Groundwater Treatment) and 5 (Excavation of Sludge and Groundwater Treatment), are implementable using proven technologies. Alternative 5c (Biological Treatment of Sludge) would require a treatability study to determine the effectiveness of biological treatment of Site-specific contaminated sludge.

5. Cost includes both the capital (investment) costs to implement an alternative, plus the long-term O&M expenditures applied over a projected period of operation. The total present worth cost for each of the five (5) alternatives is presented in Table 8-1.

8.3 Modifying Criteria

State acceptance and community acceptance are two (2) additional criteria that are considered in selecting a remedy, once public comment has been received on the Proposed Plan.

1. State acceptance: The State of South Carolina concurs with the selection of Alternative 5c, the preferred alternative outlined in the proposed plan. South Carolina's letter of concurrence is provided in

Appendix A to this ROD.

2. Community acceptance During the Proposed Plan public meeting, held on June 29, 1993, EPA presented its preferred alternative, Alternative 5c, for the remediation of the Site. The public comment period opened on June 22, 1993, and closed on July 21, 1993. No written comments were received concerning the Para-Chem Southern Site. Comments expressed at the public meeting are addressed in the Responsiveness Summary attached as Appendix B to this ROD.

9.0 THE SELECTED REMEDY

Based upon consideration of the requirements of CERCLA, the NCP, the detailed analysis of alternatives and public and state comments, EPA has selected a remedy that addresses soil and groundwater contamination at this Site. At the completion of this remedy, the risk remaining at this Site will be within EPA's acceptable risk range of 1 x 10[-4] to 1 x 10[-6], which is considered protective of human health and the environment. The selected remedy for this Site is:

Alternative 5c: Excavation and Biological Treatment of Sludge combined with Groundwater Extraction and Treatment

Total Present Worth Costs: $5,498,000.00

9.1 Source Control

Source control remediation will address the contaminated sludge and/or soils at the Site. Sludge excavation involves the removal of affected materials from an identified area followed by treatment or disposal. The purpose of excavation is to physically remove the source of waste contaminants to prevent potential future migration of wastes. This technology is viable and effective in minimizing future impact to groundwater, assuming that all significant sources of waste contaminants are located and excavated. The solid wastes requiring treatment are estimated to consist of approximately 200 in-place cubic yards of affected sludge.

The major components of source control include the excavation of contaminated sludge and/or soil until the remaining materials achieve the concentrations established as performance standards as described in Section 9.3 of this ROD. Following sludge removal the in-ground concrete tank will be removed and sampled to evaluate proper disposal options. Subsurface soils adjacent to sludge may also be contaminated and therefore violate the performance standards. The extent of subsurface soil excavation would be determined by collection and analysis of confirmation samples from underlying soil after the removal of the sludge and visibly-affected soil. The subsurface soil shall be excavated until the remaining soil achieves the performance standards or the water table is encountered.

Clean backfill would be placed in the excavated concrete settling basin. The graded cover would be sown with shallow-rooted grasses to reduce erosion. The restored area would receive periodic maintenance and inspection.

The excavated sludge will be treated through the use of the operational on-Site waste treatment unit. This unit will be used to biologically degrade the organic chemicals present in the sludge. The unit will be required to continue to meet the requirements of all applicable federal, state, or local permit conditions. The system typically consists of the following units:

- Equalization tank
- Activated Sludge unit
- Settling unit
- POTW disposal

This treatment process could require preprocessing of the solids to remove debris and to reduce the particle size of the waste matrix. Additionally a high moisture content will be required for implementation of this alternative. Sludge would be added incrementally to the existing process waste stream following any necessary pretreatment process.

The operating waste treatment system is currently treating volatile organic compounds present in the process waste stream. The compound 1,1,1TCA is the only contaminant of concern not present in the current waste stream. Specific system details for biological destruction of all contaminants of concern within the available treatment unit would be developed as a part of the remedial design phase of the project.

Adjacent contaminated soil will be transported to a regulated facility. This decision is based on the small volume of contaminated soil expected at this Site. Any portions of the contaminated sludge and related material that is unsuitable for biological treatment will also be sent to a regulated facility and disposed of in compliance with all ARARs. If necessary, excavated wastes would be treated on-Site using stabilization technologies in order to meet the appropriate land disposal treatment requirements. Excavated material would then be transported by a licensed hazardous-waste transporter to an offSite hazardous waste disposal facility permitted to dispose of RCRA hazardous wastes. Each treatment facility evaluated during remedial design will be fully operational and in compliance with the applicable regulations. Disposal of treatment residuals would be in accordance with facility permit requirements.

The selected waste transporter must be in compliance with applicable federal and state ARARs identified for the waste contaminants identified at the Site. If necessary, RCRA manifests, as required under 40 C.F.R. Parts 262 and 263, would be completed for all wastes shipped off-Site. Vehicles transporting from the Site would be licensed by the Department of Transportation (DOT) and would display the proper DOT placard.

9.1.1 Sludge/Soil Performance Standards

Protective levels of subsurface sludge and soil contaminants were based on the results of a leaching model using Site-specific information conducted in the FS. Three sludge samples exhibited concentrations in excess of the levels for 1,1-Dichloroethene, Tetrachloroethene, Toluene, and

1,1,1Trichloroethane. Some of the RI subsurface soil samples did not exceed these standards; however, performance standards were established as a contingency to allow the remedial action to proceed in the event subsurface contaminant concentrations exceeding these standards are encountered. There are no established federal or state standards for acceptable levels of contaminants in subsurface sludges and soils.

The levels presented in the following section will be established as performance standards for this Site. The initial performance standards as presented in the FS and proposed plan included calculation errors. These corrections have been made and are incorporated into Table 9-1 and do not create a different level of performance.

The standards outlined in this section comprise the performance standards defining successful implementation of this portion of the remedy. The Performance Standards for this component of the selected remedy include the following excavation and treatment standards:

9.1.2 Excavation and Treatment Standards

The performance standards presented in Table 9-1 shall control the excavation procedures for this Site. Additionally, all on-Site excavation work shall comply with 29 C.F.R. 1910.120, the OSHA health and safety requirements applicable to remedial activities. Additional waste characterization of the contaminated sludge and soil will be performed during the remedial design to determine any necessary treatment standards. The treatment and disposal shall comply with applicable or relevant and appropriate requirements (ARARs), including RCRA, TSCA, and the SCHWMR.

9.1.3 Applicable or Relevant and Appropriate Requirements (ARARs)

ARARs originate from applicable requirements, intended to definitely and specifically apply to a remedial action; or relevant and appropriate requirements, which, while not intended to apply to the specific situation in question, EPA judges to be applicable to a remedial action. In addition, when establishing criteria for ensuring the proper implementation of a remedial action, EPA and the State have agreed to consider a number of procedures that are not legally binding.

Applicable Requirements. Soil remediation shall comply with all applicable portions of the following Federal and State of South Carolina regulations:

49 C.F.R. Parts 107, 171-179, promulgated under the authority of the Hazardous Materials Transportation Act. Regulates the labelling, packaging, placarding, and transport of hazardous materials off-Site. 40 C.F.R. Parts 261, 262 (Subparts A-D), 263, 264, and 268, promulgated under the authority of the Resource Conservation and Recovery Act. These regulations govern the identification, transportation, manifestation, and land disposal restriction requirements of hazardous wastes in addition to closure and groundwater monitoring requirements. If the contaminated soils fail TCLP, the material will be handled and disposed of as hazardous waste. To determine if the materials which fail TCLP are subject to land disposal restrictions in 40 C.F.R. Part 268, EP toxicity test will be performed as appropriate. Should the materials fail the EP Toxicity test, the material will be subject to the

referenced land disposal restrictions. However, if EP toxicity tests are performed and the contaminated soils do not exceed EP toxicity limits, then the land disposal restrictions in 40 C.F.R. Part 268 will not apply, even though the contaminated soils fail TCLP. In the event that the Site soils requiring remediation do not test hazardous (i.e., do not fail TCLP), the regulations listed here will be considered relevant and appropriate rather than applicable.

SCHWMR 61-79.124, .261, .262, .263 and .268, South Carolina Hazardous Waste Management Regulations, promulgated pursuant to the Hazardous Waste management Act, SC Code of Laws, 1976, as amended. Establishes criteria for identifying and handling hazardous wastes, as well as land disposal restrictions. These regulations will also become relevant and appropriate in the event that the soils requiring remediation do not prove to be hazardous, as described in the above paragraph.

Relevant and Appropriate Requirements. The following regulations are "relevant and appropriate" to sludge and/or soil remedial actions at the Site. Applicability of these air quality control regulations is due to the potential for release of harmful particulates (metals) or VOCs during soil excavation and handling activities. 40 C.F.R. Parts 60 and 61, promulgated under the authority of the Clean Air Act. Included are the National Emissions Standards for Hazardous Air Pollutants (NESHAPs). Ambient air quality standards and standards for emissions to the atmosphere fall under these regulations.

SC Reg. 61-62, South Carolina Air Pollution Control Regulations and Standards, promulgated pursuant to the S.C. Pollution Control Act, SC Code of Laws, 1976, as amended. Establishes limits for emissions of hazardous air pollutants and particulate matter, and establishes acceptable ambient air quality standards within South Carolina.

9.2 Groundwater Remediation

Groundwater remediation will address the contaminated groundwater at the site. Groundwater remediation will include the extraction of contaminated groundwater, treatment, and discharge to WCRSA.

The major components of groundwater remediation to be implemented include the operation of the existing (or modified) groundwater extraction and treatment program. The existing operation consists of the extraction and treatment by airstripping of contaminated groundwater at the Site. This will include the following components:

- long term monitoring as presented in Alternative 1,
- institutional controls as presented in Alternative 2,
- groundwater flow containment and extraction,
- groundwater treatment, and
- discharge of treated water to WCRSA in accordance with all applicable regulations and other Performance Standards.

The extraction, treatment, and discharge of contaminated groundwater would initially be accomplished by using the fourteen (14) recovery wells (RW-4 through RW-17) that are currently operating at the Site. The system will operate for approximately thirty (30) years. The wells extend in an arc from south to north approximately parallel to the eastern property line. During the Remedial Design/Remedial Action phases of the project, the need for upgrades to the existing system, including the addition of bedrock extraction wells will be evaluated. In the interim, recovery wells RW-2 and RW-3 will be upgraded and added to the existing jet pump extraction system. The well locations are shown in Figure 6-3. Currently, the wells from W-4 through RW-17) extract approximately thirty (30) gallons per minute (gpm). During the Remedial Design phase, the air emissions from the stripper exhaust will be estimated and the impact to human health and the environment will be assessed. The use of a control technology (e.g. carbon adsorption) may be necessary if warranted by the assessment.

Para-Chem has an operating permit (IO-1182) for discharge of treated water to the Western Carolina Regional Sewer Authority (WCRSA). WCRSA requires monthly monitoring of discharge to evaluate treatment system performance. The authority currently requires that Para-Chem effluent be monitored on a monthly basis for volatile organic compounds and zinc. The treatment program proposed under this alternative would continue those analyses, as prescribed by WCRSA, in addition to any other monitoring which may be required by WCRSA.

In addition to groundwater extraction and treatment from the saprolite, two (2) recovery wells will be installed within the shallow bedrock zone adjacent to bedrock borings B-1 and B-8. EPA may require the conversion of several of the bedrock borings to monitoring points. Each interval containing detectable concentrations of VOCs will be monitored.

9.2.1 Groundwater Performance Standards

In the FS, groundwater concentrations protective of human health and the environment were calculated based on the Site-specific risk calculations from the Baseline Risk Assessment. Some of the remediation goals areestablished in cases where there is no MCL for a particular contaminant. Specific contaminants for which health-based goals were established were acetone, 2butanone, chloroform, and 1,1-dichloroethane. The remediation goal for 1,1,2-trichloroethane are based on the MCLG for this contaminant. Aluminum, manganese, and zinc remediation goals were based on secondary MCLs for these contaminants.

The groundwater remediation goals in Table 9-2 below shall be the performance standards for groundwater treatment. Groundwater shall be treated until the following maximum concentration levels are attained.

As part of the remedial design, sufficient additional groundwater and surface water data shall be collected to achieve the following objectives:

A. Verify the presence or absence of contamination beyond the existing series of recovery wells. This will include identifying areas of contaminated groundwater that the existing system will not adequately remediate. Capture zone modeling will be performed using several different scenarios.

B. Confirm the contributing source of contamination in the surface water within the on-Site tributary of Big Durbin Creek.

Attainment of these objectives must be accomplished during the first portion of remedial design, so that design of the extraction and treatment system has, as is basis, an accurate conceptual model of Site conditions. Confirmation of the extent of contamination will also require collection of further information and data for characterizing the specific hydrogeology of the Site, and will include modelling as appropriate.

9.2.3 Applicable or Relevant and Appropriate Requirements (ARARs)

ARARs originate from applicable requirements, intended to definitely and specifically apply to a remedial action; or relevant and appropriate requirements, which, while not intended to apply to the specific situation in question, EPA judges to be applicable to a remedial action. In addition, when establishing criteria for ensuring the proper implementation of a remedial action, EPA and the State have agreed to consider a number of procedures that are not legally binding.

Groundwater remediation shall comply with all applicable portions of the following federal and State of South Carolina regulations:

40 C.F.R. Parts 60 and 61, promulgated under the authority of the Clean Air Act. Included are the National Emissions Standards for Hazardous Air Pollutants (NESHAPs). Standards for emissions to the atmosphere fall under these regulations. Applicable to the air stripping unit to be used for groundwater treatment.

SC Reg. 61-58, South Carolina Primary Drinking Water Regulations, promulgated pursuant to the Safe Drinking Water Act, SC Code of Laws, 1976, as amended. These regulations are similar to the federal regulations described above, and are relevant and appropriate as remediation criteria for the same reasons set forth above.

SC Reg. 61-62, South Carolina Air Pollution Control Regulations and Standards, promulgated pursuant to the Pollution Control Act, SC Code of Laws, 1976, as amended. Establishes limits for emissions of hazardous air pollutants and particulate matter, and establishes acceptable ambient air quality standards within South Carolina. This regulation is applicable in the same manner as the federal regulation cited above.

40 C.F.R. Part 122, 125, 129, 133 and 136, CWA Discharge Limitations (CWA 301), promulgated under the authority of the Clean Water Act. Applicable to any point discharges of wastewaters to waters of the United States. Applicable to discharge of treated waters.

40 C.F.R. 403.5, CWA Pretreatment Standards (CWA 307), promulgated under the authority of the Clean Water Act. Regulates discharges of water to POTWs.

SC Reg. 61-68, South Carolina Water Classifications and Standards, promulgated pursuant to the Pollution Control Act, SC Code of Laws, 1976, as amended. These regulations establish classifications for water use, and set numerical standards for protecting state waters.

SC Reg. 61-71, South Carolina Well Standards and Regulations, promulgated under to the Safe Drinking Water Act, SC Code of Laws, 1976, as amended. Standards for well construction, location and abandonment are established for remedial work at environmental or hazardous waste Sites.

40 C.F.R. Part 131, Ambient Water Quality Criteria (CWA 304), promulgated under the authority of the Clean Water Act. Sets numerical criteria for ambient water quality based on toxicity to aquatic organisms and human health.

40 C.F.R. Parts 141-143, National Primary and Secondary Drinking Water Standards, promulgated under the authority of the Clean Water Act. These regulations establish acceptable maximum levels of numerous substances in public drinking water supplies, whether publicly owned or from other sources such as groundwater. Maximum Contaminant Levels (MCLs) and Maximum Contaminant Level Goals (MCLGs) are specifically identified in the NCP as remedial action objectives for groundwaters that are current or potential sources of drinking water supply (NCP 40 C.F.R. 300.430(a)(1)(ii) (F). Therefore, MCLs and MCLGs are relevant and appropriate as criteria for groundwater remediation at this Site.

Various to be considered (TBC) materials were utilized in the Baseline Risk Assessment and in the Feasibility Study. Because cleanup standards were established based on these documents, they are considered TBC. In the Baseline Risk Assessment, TBC material included information concerningtoxicity of, and exposure to, Site contaminants. TBC material included the Integrated Risk Information System (IRIS), Health Effects Assessment Summary Table (HEAST), and other EPA guidance as specific in the Baseline Risk Assessment. Other TBC material include the following.

Revised Procedures for Planning and Implementing Off-Site Response Actions, OSWER Directive 9834.11, November 1987. This directive, often referred to as "the off-Site policy," requires EPA personnel to take certain measures before CERCLA wastes are sent to any facility for treatment, storage, or disposal. EPA personnel must verify that the facility to be used is operating in compliance with 3004 and 3005 of RCRA, as well as all other federal and state regulations and requirements. Also, the permit under which the facility operates must be checked to ensure that it authorizes (1) the acceptance of the type of wastes to be sent, and (2) the type of treatment to be performed on the wastes.

40 C.F.R. Part 50, promulgated under the authority of the Clean Air Act. This regulation includes the National Ambient Air Quality Standards (NAAQS), and establishes a national baseline of ambient air quality levels. The state regulation which implements this regulation, South Carolina Reg. 62-61, is applicable to the source control portion of the remedy.

Guidelines for Ground Water Use and Classification, EPA Ground Water Protection Strategy, U.S. EPA, 1986. This document outlines EPA's policy of considering a Site's groundwater classification in evaluating possible remedial response actions. As described under Section 1.4, the groundwater at the Site is classified by EPA as Class IIB and by South Carolina as Class GB groundwater, indicating its potential as a source of drinking water.

National Oceanic and Atmospheric Administration (NOAA) ER-L/ER-M Values. These guidelines were developed as screening criteria for sediment contamination in surface water bodies, and are based on toxicity to aquatic life.

40 C.F.R. Part 50, National Ambient Air Quality Standards (NAAQS), promulgated under the authority of the Clean Air Act. This regulation includes the National Ambient Air Quality Standards (NAAQS), and establishes a national baseline of ambient air quality levels. The state regulation which implements this regulation, South Carolina Reg. 62-61, is applicable to the groundwater portion of the remedy.

Clean Air Act, 501 and 502, 1990 CAA Amendments, 42 U.S.C. 7661 and 7661(a). The amendments will require that all "major sources" and certain other sources regulated under the CAA obtain operating permits. Although CERCLA 121(e) exempts this remedy from requiring such a permit, air stripping at this Site may have to comply with any substantive standards associated with such permits. Regulations have been proposed, but not promulgated, for the operating permit program.

Remedial design often includes the discovery and use of unforeseeable, but necessary, requirements, which result from the planning and investigation inherent in the design process itself. Therefore, during design of the source control or groundwater component of the selected remedy, EPA may, through a formal ROD modification process such as an Explanation of Significant Differences or a ROD Amendment, elect to designate further ARARs which are applicable, or relevant and appropriate, to this remedy.

Discharge of treated groundwater to the POTW shall comply with all applicable WCRSA industrial pretreatment standards, as well as any other effluent standards or limits established by EPA.

9.4 Compliance Testing

The selected remedy will include groundwater extraction for an estimated period, during which the system's performance will be carefully monitored on a regular basis and adjusted as warranted by the performance data collected during operation. Modification may include any or all of the following:

- at individual wells where cleanup goals have been attained, pumping may be discontinued;

- alternating pumping at wells to eliminate stagnation points;

- pulse pumping to allow aquifer equilibration and encourage adsorbed contaminants to partition into groundwater; and

- installation of additional extraction wells to facilitate or accelerate cleanup of the contaminant plume.

To insure that cleanup goals continue to be maintained, the aquifer will be monitored at those wells where pumping has ceased on a regular periodic basis, following discontinuation of groundwater extraction. The intervals between groundwater sampling/analysis events will be established in the Remedial Action Work Plan.

The decision to invoke any or all of these measures may be made during a periodic review of the remedial action (Five Year Review), which will occur at five year intervals in accordance with CERCLA Section 121(c), 42 U.S.C. 9621(c).

9.5 Monitor Site Groundwater and Surface Water

Beginning with initiation of the remedial design, groundwater and surface water samples shall be collected and analyzed on a regular quarterly schedule. Analytical parameters for groundwater and surface water samples will include the known Site contaminants of concern. The specific wells to be sampled and methodology for sample collection will be determined during design. Surface water samples will be collected, as a minimum, from the unnamed tributary at one upstream location and one downstream location as necessary to monitor the contamination. The analytical data generated from the quarterly sampling events will be used to track the concentrations and movement of groundwater contaminants until a long-term Site monitoring plan is implemented in the remedial action phase.

10.0 STATUTORY DETERMINATIONS

The selected remedy for this Site meets the statutory requirements set forth at Section 121(b)(1) of CERCLA, 42 U.S.C. 9621(b)(1). This section states that the remedy must protect human health and the environment; meet ARARs (unless waived); be cost-effective; use permanent solutions, and alternative treatment technologies or resource recovery technologies to the maximum extent practicable; and finally, wherever feasible, employ treatment to reduce the toxicity, mobility or volume of the contaminants. The following section discusses how the remedy fulfills these requirements.

Protection of human health and the environment: The selected remedy will remove the human health risks from contact with contaminated Site sludge and soils. The groundwater remediation system will extract and treat contaminated groundwater, thereby reducing and eventually removing the future risks to human health which could result from ingestion of or contact with groundwater.

Compliance with ARARs: The selected remedy will meet ARARs, which are listed in Section 9.1.2 of this ROD.

Cost effectiveness: Among the alternatives that are protective of human health and the environment and comply with ARARs, the selected alternative is the most cost-effective choice because it uses a treatment technology to address the sludge which is acting as a source of contamination for the groundwater. This approach will reduce the volume of groundwater that will need to be treated. The selected alternative is the most cost-effective choice because it uses a well proven widely-used treatment method for which costs can be reliably predicted (air stripping), and because the use of the

POTW optionis the most cost-effective means to dispose of the treated groundwater.

Utilization of permanent solutions, and alternative treatment technologies or resource recovery technologies to the maximum extent practicable: The selected remedy represents the maximum extent to which permanent solutions and treatment can practicably be used for this action. The selected remedy components are considered permanent solutions.

Among the alternatives that are protective of human health and the environment and comply with all ARARs, EPA and the State of South Carolina have determined that the selected remedy achieves the best balance of trade-offs in terms of long-term effectiveness and permanence, reduction of toxicity/mobility/volume, short-term effectiveness, implementability, and cost. The selected action is more readily implementable than the other alternatives considered, and utilizes the most cost-effective option for disposal of sludge, soil, and treated groundwater. The selected sludge and soil remedial action is the most practical and easily implemented alternative, given the relatively small volume of sludge requiring remediation (approximately 200 cubic yards).

Preference for treatment as a principal remedy element: The proposed alternative will fulfill the preference for treatment as a principal element through the extraction and treatment of contaminated groundwater in addition to the excavation and biological treatment of sludge.